

WHAT IS CLAIMED AS NEW AND DESIRED TO BE SECURED BY LETTERS PATENT OF
THE UNITED STATES IS:

1. A multi-beam scanning device comprising:
a laser diode array having at least three light emitting
points arranged in a package at an equal interval and configured
to emit respective laser beams that form corresponding laser
beam spots on a recording medium at a minimum recording interval,
wherein

the laser beams from the at least three light emitting
points scan the recording medium in a main scanning direction
while being at least one of on and off so as to form a light
image having the minimum recording interval on the recording
medium,

the equal interval is not greater than the minimum
recording interval, and

the at least three light emitting points are arranged such
that the corresponding laser beam spots on the recording medium
are arranged at least one of in a line and substantially in a
line in a direction orthogonal to the main scanning direction.

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2. The multi-beam scanning device according to Claim 1
wherein any one of the laser beams is used as a clock laser beam
configured to determine a timing of starting each main scanning.

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3. The multi-beam scanning device according to Claim 2,
further comprising:

an abnormal lighting detector configured to detect

abnormal lighting of the one of the at least three light emitting points configured to emit the clock laser beam; and

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a laser beam changer configured to change the clock laser beam to any one of the laser beams emitted by the other light emitting points normally emitting a laser beam, when the abnormal lighting detector detects abnormal lighting.

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4. The multi-beam scanning device according to Claim 1, wherein a variation in position of the at least three laser beam spots configured to be arranged substantially in a line is not greater than 21.17 μm .

5. The multi-beam scanning device according to Claim 1, wherein the equal interval is not greater than 14 μm .

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6. An image forming apparatus comprising:
a recording medium; and
a laser diode array having at least three light emitting points arranged in a package at an equal interval and configured to emit respective laser beams that form corresponding laser beam spots on the recording medium at a minimum recording interval, wherein

the laser beams from the at least three light emitting points scan the recording medium in a main scanning direction while being at least one of on and off so as to form a light image having the minimum recording interval on the recording medium,

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the equal interval is not greater than the minimum recording interval, and

the at least three light emitting points are arranged such that the corresponding laser beam spots on the recording medium
5 are arranged at least one of in a line or substantially in a line in a direction orthogonal to the main scanning direction.

7. The image forming apparatus according to Claim 6
wherein any one of the three or more laser beams is used as a
10 clock laser beam configured to determine a timing of starting each main scanning.

Sub A6 8. The image forming apparatus according to Claim 7,
further comprising:

15 an abnormal lighting detector configured to detect abnormal lighting of one of the at least three light emitting points configured to emit the clock laser beam; and
a laser beam changer configured to change the clock laser beam to any one of the laser beams emitted by the other light
20 emitting points normally emitting a laser beam, when the abnormal lighting detector detects abnormal lighting.

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A6* 9. The image forming apparatus according to Claim 5,
wherein a variation in position of the laser beam spots
25 configured to be arranged substantially in a line is not greater than 21.17 μ m.

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10. The image forming apparatus according to Claim 5,
b1 wherein the equal interval is not greater than 14 μm .

11. A multi-beam scanning device comprising:
5 a laser emitting means for emitting laser beams,
comprising at least three light emitting points arranged in a
package at an equal interval and configured to emit the at least
three laser beams to form corresponding laser beam spots on a
recording medium at a minimum recording interval, wherein
10 the laser beams from the at least three light emitting
points scan the recording medium in a main scanning direction
while being at least one of on and off so as to form a light
image having the minimum recording interval on the recording
medium,
15 the equal interval is not greater than the minimum
recording interval, and
the at least three light emitting points are arranged such
that the corresponding laser beam spots on the recording medium
are arranged in at least one of a line and substantially in a
20 line in a direction orthogonal to the main scanning direction.

12. The multi-beam scanning device according to Claim 11
wherein any one of the laser beams is used as a clock laser beam
configured to determine a timing of starting each main scanning.

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16* 13. The multi-beam scanning device according to Claim 12,
further comprising:

Claim 13

an abnormal lighting detection means for detecting abnormal lighting of one of the at least three light emitting points configured to emit the clock laser beam; and a laser beam changing means for changing the clock laser beam to any one of the laser beams emitted by the other three light emitting points normally emitting a laser beam, when the abnormal lighting detection means detects abnormal lighting.

Sub C1 Claim 14

14. The multi-beam scanning device according to Claim 11, wherein a variation in position of the laser beam spots arranged substantially in a line is not greater than 21.17 μm .

15. The multi-beam scanning device according to Claim 11, wherein the equal interval is not greater than 14 μm .

Sub A17 Claim 16

16. An image forming apparatus comprising:
means for recording data thereon; and
means for emitting laser beams, comprising at least three light emitting points arranged in a package at an equal interval and for emitting laser beams to form corresponding laser beam spots on the means for recording at a minimum recording interval, wherein

the laser beams scan the means for recording in a main scanning direction while being at least one of on and off so as to form a light image having the minimum recording interval on the means for recording,

the equal interval is not greater than the minimum

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recording interval, and

the at least three light emitting points are arranged such that the corresponding laser beam spots on the means for recording are arranged at least one of in a line and
5 substantially in a line in a direction orthogonal to the main scanning direction.

17. The image forming apparatus according to Claim 16 wherein any one of the laser beams from the at least three light
10 emitting points is used as a clock laser beam for determining a time to start each main scanning.

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18. The image forming apparatus according to Claim 17,
further comprising:

15 means for detecting abnormal lighting of the at least three light emitting points that is used to emit the clock laser beam; and

means for changing the clock laser beam to any one of the laser beams emitted by the other three light emitting points,
20 when the means for detecting abnormal lighting detects an abnormal lighting condition.

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19. The image forming apparatus according to Claim 16,
wherein a variation in position of the at least three laser beam
25 spots arranged substantially in a line is not greater than 21.17 μ m.

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20. The image forming apparatus according to Claim 16,
wherein the equal interval is not greater than 14 μm .

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21. A multi-beam scanning device comprising:
5 a light beam emitting array comprising three or more light emitting elements, which are arranged at predetermined locations and which emit respective laser beams to form corresponding laser beam spots on a recording medium at a minimum recording interval,
10 wherein the three or more laser beams scan the recording medium in a main scanning direction while being put on or off to form a light image having the minimum recording interval on the recording medium, wherein the three or more light emitting elements are arranged such that the corresponding laser beam spots on the recording medium are arranged in a line or substantially in a line in a direction orthogonal to the main scanning direction.
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22. The multi-beam scanning device according to Claim 21,
20 wherein the predetermined locations of the three or more light emitting elements are such that the elements are arranged at an equal interval and the equal interval is not greater than the minimum recording interval and
wherein the equal interval is Pi and wherein Pi is set
25 to fulfill the following equation:

$$\text{Pi} = (\text{fco}/\text{fcy}) \cdot (\text{Pi}' \sqrt{\beta s})$$

wherein

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f_{co} is the focal length of a light collecting element (5), which collects the light emitted from the light beam emitting array,

f_{cy} is the focal length of a light beam shaping element,
5 said light beam shaping element shaping the light beam passing the light collecting element before the light beam is reflected by a light beam deflecting element, said light beam deflecting element deflects the light beams for scanning the recording medium, wherein β_s is the lateral direction magnification in
10 the sub-scanning direction, and

wherein π' is the minimum recording interval.

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23. The multi-beam scanning device according to Claim 21, wherein a light collecting element is at least approximately
15 arranged such that the optical axis of the light collecting element passes at least approximately through the symmetrical center of the arranged of the light emitting elements.

24. The multi-beam scanning device according to Claim 23,
20 wherein the light beam array and the light collecting element are part of a subunit, which is securable to a support unit for supporting the subunit such that a relative angle of rotation around the optical axis between the subunit and the support unit is adjustable.

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25. The multi-beam scanning device according to Claim 21, wherein the light beam emitting array is constituted such that

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the predetermined locations of the light emitting elements are set such that the centers of the light beam spots on the recording medium deviate less than 1/2 from a target distance between centers of the light beam spots and a line in the main scanning 5 direction, said line being defined such that the sum of the distances of the centers of the light beam spots is minimal.

26. The multi-beam scanning device according to Claim 21, further comprising:

10 an abnormal lighting detector configured to detect abnormal lighting of one of the three or more light emitting a clock laser beam; and
a light beam changer configured to change the clock light beam to any one of the other laser beams emitted by the other 15 light emitting elements normally emitting a light beam, when the abnormal lighting detector detects abnormal lighting, wherein the abnormal lighting of the one of the three or more light emitting elements represents a deviation of at least one operating characteristic of the one light emitting element 20 from the corresponding at least one target characteristic or represents leaving a target range of target characteristics.

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